# "Data Auditing in Fog-CPS Systems"

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**Presented By**

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# Overview

1. **FOG-CPS Systems**
2. **Data Auditing in Cloud Storage**
3. **Data Auditing in FOG-CPS**
4. **Research Challenges**
5. **Conclusions**

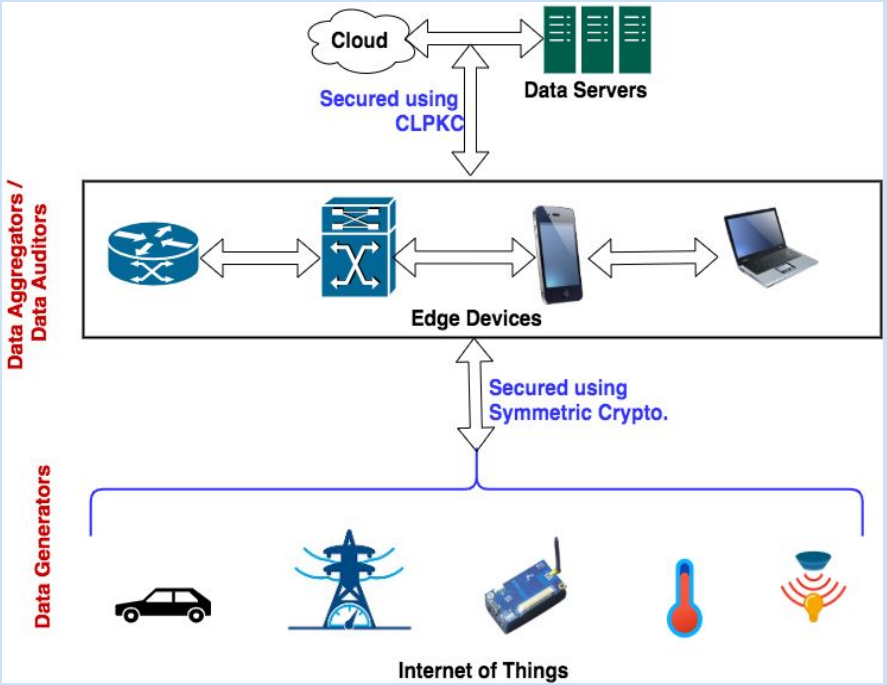
# FOG-CPS Systems


- Most convenient and efficient methods to store data
- Easily accessible and shareable
- Cost efficient
- etc.

# FOG-CPS Systems

- CPS involves handling huge amounts of data
- CPS is resource constrained
- Cloud-CPS ?
- Realtime and reliability requirements of CPS applications
- FOG Computing - provides computing at the edge of the network
- Hene, FOG-CPSs

# FOG-CPS Systems




Architecture of a Typical FOG-CPS System

# Data Auditing in Cloud Storage

## Purpose of Data Auditing in Cloud Storage

- **authenticity, integrity and availability of the data is important**
- **authenticity and integrity can be ensured by cryptography**
- **availability - ???**
  - **what if the data is deleted / lost**
  - **storage provider may not report in time**
  - **consequence - degrade performance of the user's services**
  - **crucial for safety-critical systems**

# Data Auditing in Cloud Storage

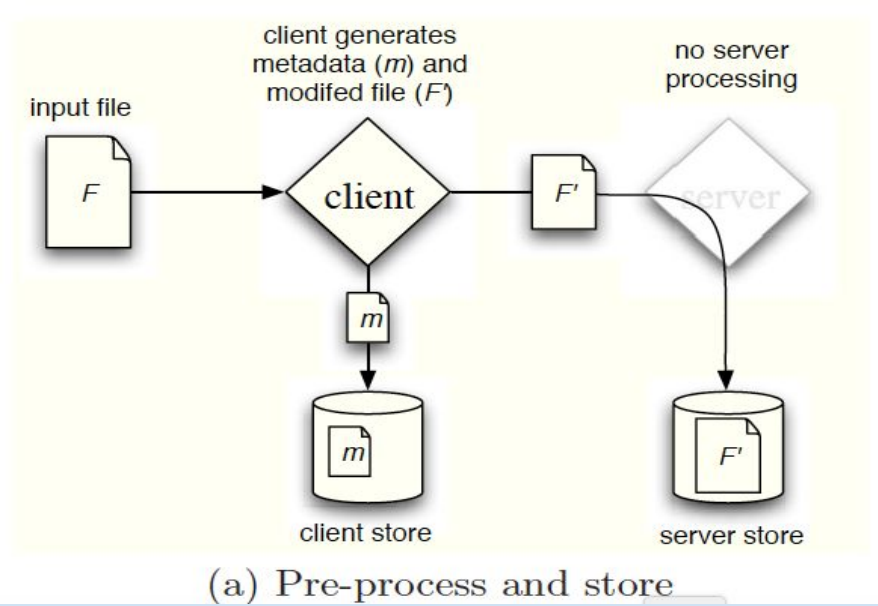
- **Availability of data stored in cloud**
  - **requires some guarantee (provable)**
  - **cloud authority can be considered semi-trusted**
  - **Users need to deploy their own mechanism**
    - **Requires regular (periodic) Data-Auditing**
      - **To ensure both Availability & Integrity of data**

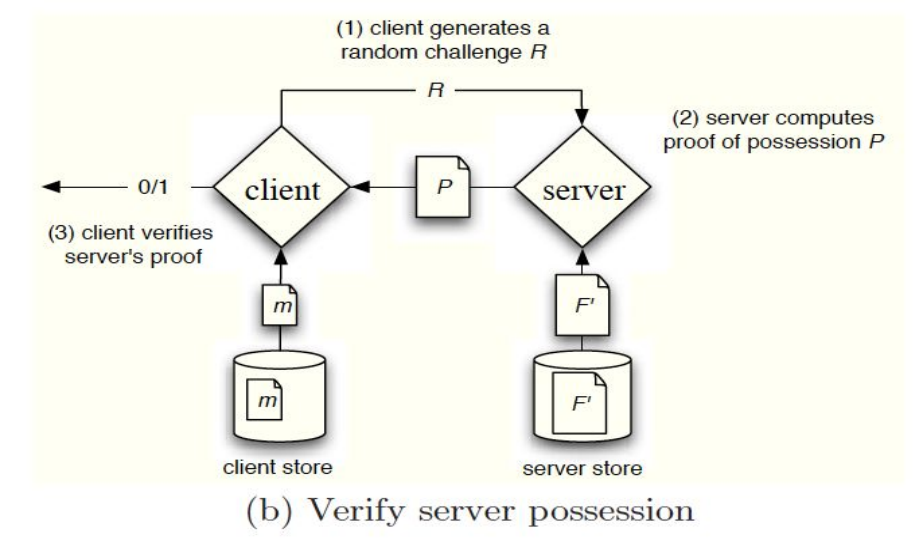
**Q. Who should do this auditing?**

**Q. How would it be done (protocol)?**

**Q. What are the challenges?**

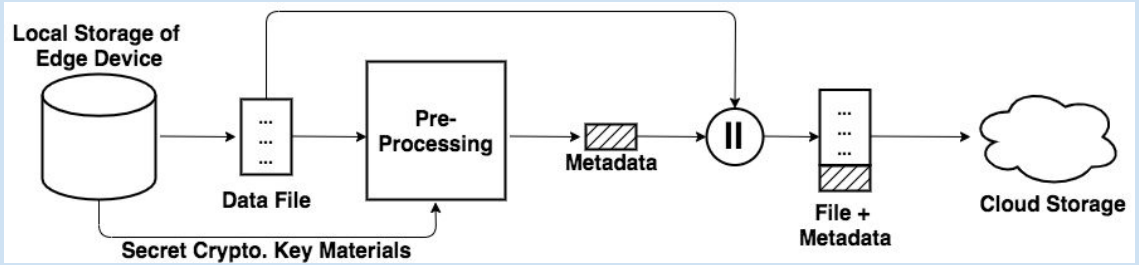
# Data Auditing in Cloud Storage



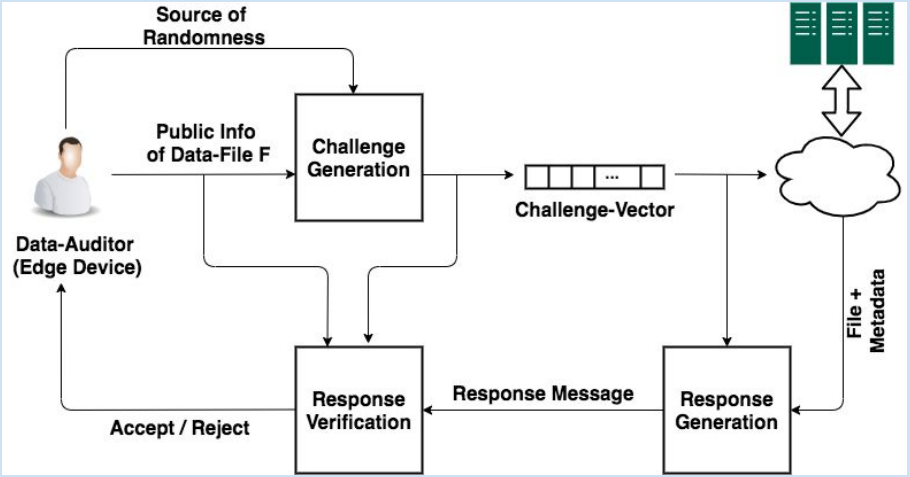




Ateniese G, Burns R, Curtmola R, Herring J, Kissner L, Peterson Z, Song D. Provable data possession at untrusted stores. InProceedings of the 14th ACM conference on Computer and communications security 2007 Oct 28 (pp. 598-609).

# Data Auditing in FOG-CPS




Metadata Generation and Data Upload




Data Auditing by an Edge Device

# Data Auditing in FOG-CPS

## Research Challenges

- **Architecture Difference**
- **Resource Constraints**
- **Reliability**
- **Data Privacy**
- **Shared Data**
- **Attacker Model**

# Data Auditing in FOG-CPS

## Research Challenges: Architecture Difference

- **Who is Data Owner?**
- **Who is Auditee?**
- **Who is the Auditor?**
- **Who is Audit Verifier?**
- **Who Provides Authentication Service?**

# Data Auditing in FOG-CPS

## Research Challenges: Resource Constraints

- **Symmetric vs Asymmetric Crypto**
- **PKI vs IBC vs CLPKC**
- **Cost of Pairing Based Cryptography**
- **Distributed Auditing**

# Data Auditing in FOG-CPS

## Research Challenges: Reliability & Data Privacy

- **Semi-Trusted Edge Devices as Auditors**
- **Verifiable Source of Randomness**
- **Audit Verification - aggregate function**
- **Zero-Knowledge Protocols**

# Data Auditing in FOG-CPS

## Research Challenges: Shared Data

- **blocks contributed by different generators**
- **with different security credentials**
- **aggregation becomes challenging**

# Data Auditing in FOG-CPS

## Research Challenges: Attacker Model

- **Type-I Adversary: external attacker tries to forge metadata**
- **Type-II Adversary: authentication server tries to forge metadata**
- **Type-III Adversary: auditee tries to forge data PoP**
- **Type-IV Adversary: auditor tries to violate data privacy**
- **Type-V Adversary: auditor tries to avoid auditing task**
- **Type-VI Adversary: auditor-auditee collusion tries to forge data PoP**

# Conclusions

- **FOG-CPS systems need to handle huge amount of data**
- **Data kept in vulnerable devices requires auditing**
- **Auditing should be done locally**
- **Reliability of Auditing is Challenging**
- **Data Privacy under Threat**
- **Efficiency Must be Ensured**

# THANK YOU